CARDIOPULMONARY ENDURANCE AND FITNESS TRAINING STRATEGIES FOR OBESE ADOLESCENTS

ESTRATÉGIAS DE TREINAMENTO DE RESISTÊNCIA CARDIOPULMONAR E APTIDÃO FÍSICA PARA ADOLESCENTES OBESOS

ESTRATEGIAS DE ENTRENAMIENTO DE RESISTENCIA CARDIOPULMONAR Y APTITUD FÍSICA PARA ADOLESCENTES OBESOS

ORIGINAL ARTICLE
ARTIGO ORIGINAL
ARTÍCULO ORIGINAL

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ABSTRACT

Introduction: Reducing the risk of obesity and maintaining healthy lifestyle habits and physical exercise is very important for adolescents in a crucial period of their development. Objective: Study the effect of physical training on cardiopulmonary resistance and physical fitness in obese adolescents. Methods: Fourteen overweight or obese adolescent students were selected from a school. The experiment lasted four weeks, and the experimental group received a systematic and professional physical training intervention, with two aerobic and two endurance training sessions each week. The control group did not perform any physical exercises except free activities in physical education classes. Results: After four weeks of training, the BMI index of the experimental group changed from 32.84 to 27.68, systolic blood pressure also changed from 118.14mmHg to 93.93mmHg, and diastolic blood pressure was from 69.83mmHg to 55.34mmHg. Conclusion: Elevating professional physical training in adolescents' physical education has shown to be an important attitude to reduce and prevent obesity and its comorbidities. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Adolescent; Obesity Management; Physical Education and Training.

RESUMO

Introdução: A redução do risco de obesidade e a manutenção de hábitos de vida saudáveis além do exercício físico são muito importantes para os adolescentes que estão em um período crucial de seu desenvolvimento. Objetivo: Estudar o efeito do treinamento físico sobre a resistência cardiopulmonar e a aptidão física em adolescentes obesos. Métodos: Catorze estudantes adolescentes obesos ou com excesso de peso foram selecionados em uma escola. A experiência teve duração de quatro semanas onde o grupo experimental recebeu uma intervenção sistemática e profissional de treinamento físico, com um total de dois treinamentos aeróbicos e dois de endurance a cada semana. O grupo de controle não realizou exercícios físicos, exceto as atividades livres nas aulas de educação física. Resultados: Após 4 semanas de treinamento, o índice de IMC do grupo experimental mudou de 32,84 para 27,68, a pressão arterial sistólica também sofreu alterações de 118,14mmHg para 93,93mmHg, e a pressão arterial diastólica foi de 69,83mmHg para 55,34mmHg. Conclusão: Elevar o treinamento físico profissional na educação física dos adolescentes mostra-se uma atitude importante para reduzir e prevenir a obesidade e suas comorbidades. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Adolescente; Manejo da Obesidade; Educação Física e Treinamento.*

RESUMEN

Introducción: La reducción del riesgo de obesidad y el mantenimiento de hábitos de vida saludables además del ejercicio físico son muy importantes para los adolescentes que se encuentran en un periodo crucial de su desarrollo. Objetivo: Estudiar el efecto del entrenamiento físico sobre la resistencia cardiopulmonar y la forma física en adolescentes obesos. Métodos: Se seleccionaron catorce estudiantes adolescentes con sobrepeso u obesidad en un centro escolar. El experimento duró cuatro semanas en las que el grupo experimental recibió una intervención sistemática y profesional de entrenamiento físico, con un total de dos sesiones de entrenamiento aeróbico y dos de resistencia cada semana. El grupo de control no realizó ejercicios físicos, salvo actividades libres en las clases de educación física. Resultados: Después de 4 semanas de entrenamiento, el índice de IMC del grupo experimental cambió de 32,84 a 27,68, la presión arterial sistólica también cambió de 118,14mmHg a 93,93mmHg, y la presión arterial diastólica fue de 69,83mmHg a 55,34mmHg. Conclusión: Aumentar la preparación física profesional en la educación física de los adolescentes demuestra ser una actitud importante para reducir y prevenir la obesidad y sus comorbilidades. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Adolescente; Manejo de la Obesidad; Educación y Entrenamiento Físico.*

DOI: http://dx.doi.org/10.1590/1517-8692202329012022_0744 Article received on 11/30/2022 accepted on 12/14/2022

INTRODUCTION

According to the existing research, obesity and overweight have become a common metabolic disease with a high incidence rate, especially among teenagers, which is one of the focuses of school physical education at this stage.[1] Obesity is mainly reflected in the excessive accumulation or uneven distribution of fat in the human body due to the imbalance of energy intake and consumption.[2] Obesity is usually accompanied by abnormal metabolism, decline of cardiopulmonary function, endocrine function and limb coordination ability, and also has an important impact on the psychological health, academic performance and other dimensions of

adolescents in the critical period of development.[3] Therefore, the problem of adolescent obesity has gradually become a medical and physical education problem that attracts much attention from the society. It is important for PE teachers and parents to choose reasonable training methods according to the actual health status of young people because young people need to combine their own characteristics and obesity level when carrying out sports training.[4] Although most of the physical training can reduce the obesity level of obese adolescents, the effect of endurance training and joint training is more significant, which can effectively improve the cardiorespiratory endurance and basic physical fitness of obese adolescents, so as to further improve their sports ability and metabolic function.[5] Based on this, this paper selected some obese teenagers as the subjects to study the improvement effect of physical training on the students' cardiorespiratory endurance and other health indicators.[6] By comparing the changes in the basic physical conditions, physical indicators and cardiopulmonary endurance of the adolescents before and after the 4-week training, it is proved that physical training has a significant impact on the promotion of the health level of obese adolescents, which provides a certain reference for further improving the health level of adolescents.[7]

METHOD

Subject of experiment

In this study, we collected the basic information of obese students at this stage, combined with the interview and investigation of some physical education teachers and previous research materials, and determined the relevant experimental program. The study and all the participants were reviewed and approved by Ethics Committee of Wuhan Sports University (NO.WHSTU20FD118). First, 16 obese or overweight young students were recruited through a middle school. The subjects were all male students in grade two of junior high school, with BMI index no less than 25 (kg/m2) and body fat rate no less than 30%. The subjects had no major diseases and no injuries in the past six months, all of which met the basic requirements of fitness training. According to the communication, make sure that the subject, the head of the class and the guardian clearly understand the purpose and method of the experiment and sign the consent form. The students were randomly divided into experimental group and control group.

Experiment cycle and intervention plan

The experiment lasted for 4 weeks, and the basic information of the students was tested before and after the experiment. Among them, the experimental group carried out systematic and professional physical training intervention. The training was carried out according to the frequency of physical education classes. Two aerobic training and two endurance training were carried out every week. The effective training time of each training should not be less than 20 minutes. At the beginning and end of the training, preparation activities and stretching activities were carried out under the guidance of the coach. The students in the control group did not take physical exercise except for free activities in physical education class, and the free activities in physical education class mainly focused on walking. During the experimental period, the subjects kept a relatively consistent state in their diet, daily life, etc., to minimize the interference of external factors.

Test indexes and methods

This experiment refers to the theory and method of adolescent physical fitness test and previous research, and selects four aspects of basic physical conditions, physical fitness indicators, cardiopulmonary endurance and blood indicators to conduct pre-test and post test for the students. Among them, the basic physical conditions were tested for four indicators: weight, BMI, body fat rate and muscle mass. The height and weight meter and In Body intelligent body fat scale were mainly used to measure the specific data of obese students wearing light clothing.

Physical indicators are measured by the results of four sports, namely, standing with eyes closed and one leg standing, sitting forward bending, standing long jump and flat support. The electronic timer, sitting forward bending tester, soft leather ruler and gymnastics mat are mainly used to measure the short distance and duration.

Cardiopulmonary endurance indexes are mainly measured by 1000m, 50m, systolic blood pressure and diastolic blood pressure, 1000m and 50m are both in the form of vertical starting, and blood pressure is measured by arm type electronic sphygmomanometer.

RESULTS

Changes in basic physical conditions of obese adolescents

After four weeks of physical training, the changes of four indicators of the basic physical condition of the tested students were first counted and compared. The specific results are shown in Table 1.

It can be seen from the data in Table 1 that for the students of the experimental group and the control group, the changes in BMI indicators before and after training are the largest. The BMI index of the experimental group changed from 32.84 ± 3.7529 before training to 27.68 ± 3.6452, and the BMI index of the control group changed from 30.69 ± 3.8226 before training to 26.66 ± 3.4933. In addition, the change range of the body fat rate of the two groups of students is also obvious. The body fat rate of the experimental group decreases from 35.49 ± 4.3452% before training to 29.93 ± 5.5253%, and the body fat rate of the control group decreases from 33.30 ± 4.3353% before training to 31.73 ± 5.6067%. The weight change rate of the two groups of students was small, but both showed a decreasing trend. The weight of the experimental group decreased from 83.66 ± 15.6337kg before training to 74.54 ± 13.7664kg, and the weight of the control group decreased from 81.46 ± 16.5450kg before training to 74.63 ± 14.4478kg. The range of the control group was small. The change rate of muscle mass in the two groups before and after the experiment was small, but showed a downward trend. The change rate in the experimental group was relatively obvious, from 48.97 ± 8.7916kg before training to 47.24 ± 7.9239kg, and the control group from 49.27 ± 8.4049kg before training to 48.14 ± 7.6352kg.

In order to further study the change trend of basic physical conditions of obese adolescents after four weeks of physical training, the change rates of four indicators are compared, as shown in Figure 1.

It can be seen from the data change chart in Figure 1 that after 4 weeks of training, the change rate of all indicators of the control group students is higher than that of the control group, and the change rate in BMI index, body fat rate and weight is the largest, and the muscle mass also shows a certain downward trend.

Table 1. Changes in basic physical conditions of obese adolescents.

Index		Weight (kg)	BMI(kg/m²)	Body fat percentage (%)	Muscle volume (kg)
Experience group	Before experiment	83.66±15.6337	32.84±3.7529	35.49±4.3452	48.97±8.7916
	After experiment	74.54±13.7664	27.68±3.6452	29.93±5.5253	47.24±7.9239
	Rate of change	-10.9053%	-15.7000%	-15.6559%	-3.5472%
Control group	Before experiment	81.46±16.5450	30.69±3.8226	33.30±4.3353	49.27±8.4049
	After experiment	74.63±14.4478	26.66±3.4933	31.73±5.6067	48.14±7.6352
	Rate of change	-8.3867%	-13.1168%	-12.7336%	-2.2981%

Changes in physical fitness of obese adolescents

The physical indicators of the tested students before and after the experiment are tested, and the results are shown in Table 2.

It can be seen from the data in Table 2 that the physical fitness indicators of the students in the experimental group have improved significantly, especially the three indicators of standing with eyes closed, sitting forward, and flat support, with the change rates of 116.7815%, -68.3457% and 70.2768% respectively.

In addition to various sports indicators, the cardiopulmonary endurance of the students was measured and compared. The results are shown in Table 3.

After four weeks of physical training, the experimental group achieved a high improvement in the performance of 1000m and 50m, with an increase of 13.9505% and 16.0320% respectively. The performance of running ability depends on physical fitness, and one of the most important indicators is cardiopulmonary endurance. According to the test data of the systolic and diastolic blood pressure of the students in the experimental group, after four weeks of training, the blood pressure level of the obese students in the experimental group gradually tends to be normal, the systolic blood pressure recovers from 118.14 ± 12.2258mmHg to 93.93 ± 10.4298mmHg, and the diastolic blood pressure recovers from 69.83 ± 8.3032mmHg to 55.34 ± 6.7004mmHg, with very obvious changes.

Changes of blood indicators in obese adolescents

Finally, the changes of blood indicators of obese adolescents were statistically analyzed, and the results are shown in Table 4.

It can be seen from the data in Table 4 that due to the physical training, the weight, body fat rate and other indicators of the tested students have decreased to varying degrees, so the decline of the students' body fat rate and body weight level has improved blood glucose, blood lipid and cholesterol, thus improving the overall cardiovascular fitness. Among them, total cholesterol, triglyceride and low-density lipoprotein cholesterol showed a significant decline, with the change rates of -21.8766%, -48.5522% and -31.9636% respectively. High density lipoprotein cholesterol increased to a certain extent, with a change rate of 6.5666%. Fasting insulin and fasting blood glucose have also been further improved, and are closer to the normal values of teenagers than before training. Fasting insulin decreased from 11.43 ± 6.5613mIU/L before training to 10.05 ± 6.6363mIU/L, and fasting blood glucose decreased from 5.49 ± 0.7765mmol/L before training to 5.07 ± 0.6278mmol/L. The change range of fasting insulin and fasting blood glucose in the

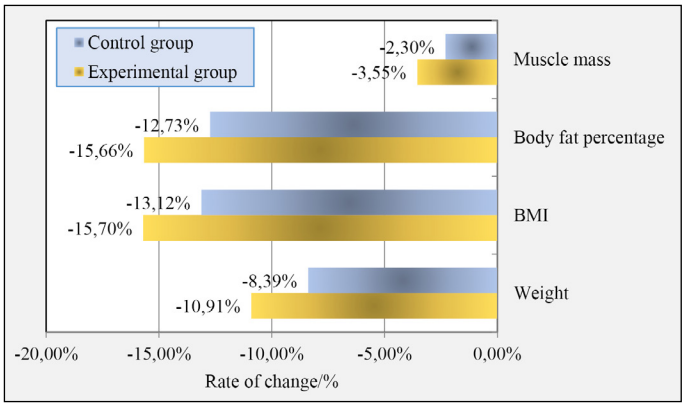

Figure 1. Changes in basic physical conditions of obese adolescents.

Table 3. Changes of cardiopulmonary endurance in obese adolescents.

Index		1000m (s)	50 m (s)	Systolic blood pressure (mmHg)	Diastolic pressure (mmHg)
Experience group	Before experiment	396.85±47.8023	10.78±0.8561	118.14±12.2258	69.83±8.3032
	After experiment	341.49±46.9927	9.05±0.7594	93.93±10.4298	55.34±6.7004
	Rate of change	-13.9505%	-16.0320%	-20.4932%	-20.7542%
Control group	Before experiment	393.25±49.0093	11.16±0.8483	121.13±11.9232	68.10±8.5971
	After experiment	377.35±38.7051	9.66±0.7786	108.18±10.7991	61.20±5.4934
	Rate of change	-4.0450%	-13.4420%	-10.6856%	-10.1299%

Table 4. Changes of blood indexes in obese adolescents.

Index		Fasting insulin (mIU/L)	Fasting blood glucose (mmol/L)	Total cholesterol (mmol/L)
Experience group	Before experiment	11.43±6.5613	5.49±0.7765	4.54±0.8493
	After experiment	10.05±6.6363	5.07±0.6278	3.54±0.7326
	Rate of change	-12.0278%	-7.8009%	-21.8766%
Control group	Before experiment	13.06±9.6597	4.90±0.5575	4.52±0.8592
	After experiment	13.02±9.6780	5.11±0.7493	3.61±0.6818
	Rate of change	-0.2745%	4.0991%	-19.9833%
Index		**Triglyceride (mmol/L)**	**High density lipoprotein cholesterol (mmol/L)**	**Low density lipoprotein cholesterol (mmol/L)**
Experience group	Before experiment	1.50±0.5063	1.04±0.1891	2.93±0.6814
	After experiment	0.77±0.2666	1.11±0.2126	1.99±0.5902
	Rate of change	-48.5522%	6.5666%	-31.9636%
Control group	Before experiment	1.00±0.3341	1.28±0.1593	2.66±0.7407
	After experiment	0.71±0.3259	1.21±0.2228	1.89±0.6614
	Rate of change	-28.4469%	-5.2590%	-28.9757%

Table 2. Changes of physical fitness indicators in obese adolescents.

Index		Stand on one leg with eyes closed (s)	Forward bending of sitting body (cm)	Standing long jump (cm)	Plate support (s)
Experience group	Before experiment	4.70±4.0401	-6.15±8.3121	155.39±19.3362	14.96±10.3179
	After experiment	10.19±5.7278	-1.95±7.9687	164.96±20.4120	25.48±15.2504
	Rate of change	116.7815%	-68.3457%	6.1604%	70.2768%
Control group	Before experiment	4.66±4.1421	-6.36±8.2368	156.31±18.8575	14.59±10.6832
	After experiment	7.56±4.3354	-3.47±8.1699	159.01±21.1346	16.71±11.3728
	Rate of change	62.4145%	-76.8595%	-22.7823%	14.5489%

control group was small. Although the decrease range of total cholesterol, triglyceride and low-density lipoprotein cholesterol was not as obvious as that in the experimental group, they remained at a high level, respectively -19.9833%, -28.4469% and -28.9757%. In addition, only high-density lipoprotein cholesterol showed a downward trend. It shows that exercise training has a significant effect on the improvement of blood indicators and cardiovascular fitness, but it needs to ensure the amount of exercise and select appropriate exercise methods to achieve a more significant improvement.

DISCUSSION

Physical training has improved the performance of obese students in standing with eyes closed, sitting forward, standing long jump and flat support, which shows the improvement of muscle adaptability of obese students from the data level. Sports performance is greatly affected by the endurance and strength level of the waist and abdomen muscles. Fat accumulation in the waist and abdomen of obese and overweight teenagers will hinder muscle contraction, affect movement coordination and explosive force, and increase energy consumption in sports. At the same time, due to their large weight, they need to overcome the heavy gravity during the exercise, which will make them more prone to fatigue, thus seriously affecting the improvement of training results. The reasons why the 4-week physical training can improve the sports performance are as follows: First, aerobic sports such as jogging and fast walking require the cooperation of arms swinging back and forth in the sports mode, which can stimulate the waist and back muscles. Maintaining body balance requires the contraction of the abdominal muscles, which to some extent consumes the abdominal fat. At the same time, the ability of blood to transport oxygen is improved, which can provide more oxygen for muscle sports and enhance muscle endurance. Endurance training includes supine Russian cycling, supine hand touching the opposite toe and other movements, which can enhance the strength and endurance level of the waist and abdomen muscles. At the same time, the increase in the volume level and number of mitochondria in muscle fibers will provide more energy and enhance the muscle's anti fatigue ability. In addition, fat and weight loss of obese and overweight adolescents will reduce muscle contraction resistance, improve muscle exercise efficiency and improve training performance.

CONCLUSION

Obesity is closely related to the level of daily diet and physical activity, and has the characteristics of complex etiology and multiple factors. For young people, the quality of life in today's society has been improved, bad eating habits have also emerged, and sedentary posture has also increased. If the body intake is greater than the activity consumption, excess calories will be stored in the body in the form of fat, which will lead to fat accumulation and weight gain, thus leading to obesity in young people. Obesity will adversely affect the blood biochemical level, body shape and quality of teenagers, leading to the decline of sports ability and physical health level. Physical exercise has a positive effect on teenagers in many ways, and can improve their health by combining exercise with moderate diet control. Exercise mainly reduces weight through negative balance of energy. Different exercise methods consume different energy, and the weight loss effect is different according to different physical conditions.

All authors declare no potential conflict of interest related to this article

AUTHORS' CONTRIBUTIONS: The author has completed the writing of the article or the critical review of its knowledge content. This paper can be used as the final draft of the manuscript. Every author has made an important contribution to this manuscript. Xue Zhang and Xiangping Zheng: writing and execution.

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